

MARKSCHEME

November 2002

BIOLOGY

Higher Level

Paper 2

Subject Details: **Biology HL Paper 2 Markscheme**

Mark Allocation

Candidates are required to answer **ALL** questions in Section A total **[32 marks]** and **any TWO** questions in Section B **[20 marks]** each. Maximum total = **[72 marks]**.

General

A markscheme often has more specific points worthy of a mark than the total allows. This is intentional. Do not award more than the maximum marks allowed for part of a question.

When deciding upon alternative answers by candidates to those given in the markscheme, consider the following points:

- ♦ Each marking point has a separate line and the end is signified by means of a semicolon (;).
- ♦ An alternative answer or wording is indicated in the markscheme by a “/”; either wording can be accepted.
- ♦ Words in (...) in the markscheme are not necessary to gain the mark.
- ♦ The order of points does not have to be as written (unless stated otherwise).
- ♦ If the candidate’s answer has the same “meaning” or can be clearly interpreted as being the same as that in the mark scheme then award the mark.
- ♦ Mark positively. Give candidates credit for what they have achieved, and for what they have got correct, rather than penalising them for what they have not achieved or what they have got wrong.
- ♦ Remember that many candidates are writing in a second language. Effective communication is more important than grammatical accuracy.
- ♦ Occasionally, a part of a question may require a calculation whose answer is required for subsequent parts. If an error is made in the first part then it should be penalized. However, if the incorrect answer is used correctly in subsequent parts then **follow through** marks should be awarded. Indicate this with “**ECF**”, error carried forward.
- ♦ Units should always be given where appropriate. Omission of units should only be penalized once. Indicate this by “**U-1**” at the first point it occurs. Ignore this, if marks for units are already specified in the markscheme.
- ♦ Do not penalise candidates for errors in significant figures, unless it is specifically referred to in the markscheme.

Section B

Extended response questions - quality of construction

- ♦ Extended response questions for HL P2 carry a mark total of 20. Of these marks, 18 are awarded for content and 2 for the quality of construction of the answer.
- ♦ Two aspects are considered:
 - expression of relevant ideas with clarity
 - structure of the answers.
- ♦ **ONE** quality mark is to be awarded when the candidate satisfies **EACH** of the following criteria. Thus **TWO** quality marks are awarded when a candidate satisfies **BOTH** criteria.

Clarity of expression:

The candidate has made a serious and full attempt to answer all parts of the question and the answers are expressed clearly enough to be understood with little or no re-reading.

Structure of answer:

The candidate has linked relevant ideas to form a logical sequence in at least two parts [(a), (b), etc.] of the question.

- ♦ It is important to judge this on the overall answer, taking into account the answers to all parts of the question. Although, the part with the largest number of marks is likely to provide the most evidence.
- ♦ Candidates that score very highly on the content marks need not necessarily automatically gain the two points for the quality of construction (and vice versa).
- ♦ The important point is to be consistent in the awarding of the quality points. For **sample scripts for moderation** the reason why quality marks have been awarded should be stated.
- ♦ Indicate the award of quality marks by writing **Q2**, **Q1** or **Q0** in **red** at the end of the answer.

SECTION A

1. (a) height 0.54 m: 60–79 cm / 0.60–0.79 m (from the plant) and height 10.8 m: 0–2.9 m (from the plant); [1]
Units needed for both parts of the answer.
- (b) the greater the height from which the seed fell, the further it travelled from the parent plant [1]
- (c) *at the greater height:*
 seed can catch the wind to travel further / updrafts / more wind at greater height; farther to the ground and does not travel straight down / more time to be blown before hitting the ground;

at lower height:
 seed can fall straight down;
 seed can hit downdraft and fall faster; [2 max]
Any point must explain the difference in distance travelled from the two heights.
- (d) *Agrostis stolonifera* [1]
- (e) *Poa trivialis* [1]
- (f) *Poa* produces seed earliest in the summer / June;
Holcus produces most seed in July;
Agrostis and *Festuca* produce seed in (late July to) August;
Holcus and *Poa* have a peak time of seed fall / short period of seed fall;
Agrostis and *Festuca* may continue to increase in seed production to September; [3 max]
Accept any of these points made conversely as an alternative.
- (g) *Award [1] each for any two of the following.*
 to avoid predation / disperse at times when other species are dispersing their seeds;
 to avoid competition;
 late in the year to allow seeds to germinate over winter / better germination conditions;
 better dispersal conditions / more wind / animals for dispersal;
 photoperiod - required day length for flowering;
 more energy stored at the end of the summer for seed production;
 more light / warmth / better conditions for seedling photosynthesis / growth; [2 max]
- (h) *Award [1] each for any two of the following.*
 tropical fruits have higher lipid content than temperate fruits;
 temperate fruits (80 %) have greater carbohydrate content than tropical fruits (55 %);
 protein levels are similar in both groups of fruits / slightly higher in temperate fruits than tropical fruits; (*must make it clear that the difference is slight*) [2 max]

- (i) mistletoe;
high proportion of lipid and carbohydrate (lipid has approximately twice the energy content of protein and carbohydrate); [2]
- (j) Award [1] for advantage and [1] for disadvantage.
animal dispersal advantage:
travel further / digestion cracks seed coat for better germination / deposited in feces with organic matter / better in areas with little wind;
animal dispersal disadvantage:
predation / seeds eaten / deposited in poor environment / buried too deep / buried too shallow (if deposited with feces) / animal might become extinct / scarce; [2 max]
2. (a) two sets of chromosomes / each chromosome represented twice;
pairs of homologous chromosomes;
Do not accept haploid number, having 46 chromosomes, $2n$ [1 max]
- (b) Both A and B must be correctly identified for [1].
A: interphase / G1, S, G2;
B: mitosis / phases of mitosis; [1]
- (c) Any three of the following [1] each.
protein synthesis / translation
DNA replication / chromosome replication;
cell growth / increase in cell volume;
organelle doubling;
microtubule formation;
respiration / glycolysis;
increase energy stores;
transcription / mRNA production;
Accept first three answers only. [3 max]
- (d) Award [1] each for the following.
animal cells:
pinching of cell membrane / form cleavage furrow;
centrioles;
plant cells:
cell plate formation;
cell wall built (during cytokinesis); [2 max]
- (e) “A” part of cycle / interphase involves DNA synthesis
replication of DNA requires complementary base pairing / A-T, G-C;
produces two identical copies of DNA / sister chromatids;
sister chromatids split at anaphase;
each new cell gets a copy of each DNA molecule / genetically identical
wrong base pairing causes mutations;
mutations can lead to cancer (by uncontrolled cell division) [3 max]

3. (a) found in Prokaryotes;
a cluster of genes for a biochemical function / group of genes concerned with a common
function / group of genes controlled / regulated together; **[2]**
- (b) mRNA production;
regulator gene produces repressor protein;
repressor protein blocks RNA polymerase binding;
which prevents transcription / no transcription;
presence or absence of lactose controls repressor binding;
lactose induces transcription; **[3 max]**

SECTION B

4. (a) chromosomes condense / coil / become shorter and fatter during prophase I;
(homologous) chromosomes pair up in prophase I;
crossing over / chiasmata formation in prophase I;
movement of pairs of chromosomes / bivalents to the equator in metaphase I;
movement of half of the chromosomes to each pole in anaphase I;
movement of chromatids to opposite poles in anaphase II;
decondensation / uncoiling in telophase II; **[5 max]**
[4 max] if no diagram is shown.
- Do not award a mark for a statement if a diagram has been drawn that does not fit in with the statement. For example, if the candidate states that pairs of chromosomes move to the equator in metaphase I but shows single chromosomes, do not award that mark.*
- (b) random orientation of bivalents / pairs of chromosomes;
maternal and paternal chromosome could go to either pole;
 2^n combinations;
e.g. over 8 million in humans;
crossing over;
exchange of material between homologous chromosomes / non-sister chromatids;
segregation of alleles in meiosis;
combinations of alleles are broken up;
fertilization brings together genes / alleles from two different parents;
fertilization generates new combinations of genes / alleles;
random fertilization / many possible combinations of male and female gamete;
e.g. over 64 million million in humans (ignoring crossing over); **[6 max]**
- (c) both involve meiosis;
both involve cell proliferation / mitosis (before meiosis);
both involve cell growth / enlargement (before meiosis);
LH / FSH involved in both;
testes versus ovaries;
spermatogenesis starts at puberty versus oogenesis starts in the fetus;
spermatogenesis until death versus oogenesis until menopause;
spermatogenesis continuously versus oogenesis in a cycle;
millions of sperm daily versus one egg per month;
ejaculation of sperm any time versus ovulation in middle of menstrual cycle;
four sperm per meiosis / spermatogonium versus one egg per meiosis / oogonium;
spermatogenesis involves equal divisions versus oogenesis involves unequal cell / cytoplasm divisions;
no polar bodies in spermatogenesis versus 2 or 3 polar bodies in oogenesis;
spermatogenesis involves Sertoli / nurse cells versus oogenesis does not;
meiosis II completed before fertilization in spermatogenesis versus after in oogenesis;
testosterone needed for spermatogenesis versus not needed for oogenesis; **[7 max]**

(Plus up to **[2]** for quality)

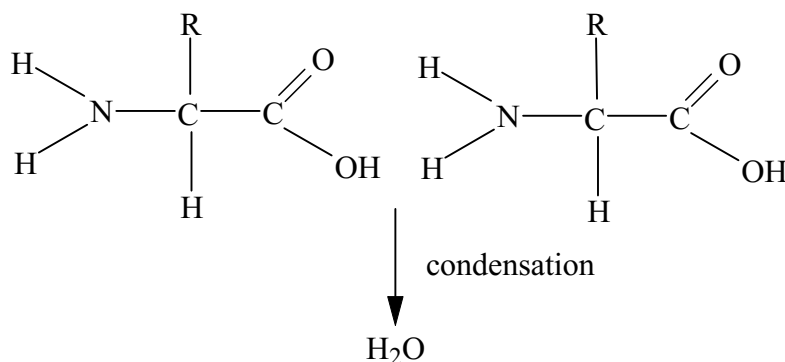
5. (a) living tissue;
composed of companion cells / sieve tube members;
companion cells involved in ATP production;
sucrose / amino acids / assimilate / products of photosynthesis transported;
bi-directional transport;
source / leaves to sink / fruits / roots / storage organs / named storage organ;
pressure flow hypothesis / movement of water into phloem causes transport; **[5 max]**
- (b) absorption of water;
(embryo) increases respiration;
(embryo) secretes GA to (aleurone layer);
(stimulates) production of amylase;
digestion of starch to smaller sugars / maltose;
mobilize to tissues / transport of foods / nutrients to embryo; **[5 max]**
- (c) less transpiration as (atmospheric) humidity rises;
smaller concentration gradient (of water vapour);
- more transpiration as temperature rises;
faster diffusion / more kinetic energy (of water molecules);
faster evaporation (due to more latent heat available);
- more transpiration as wind (speed) increases;
humid air / water vapour blown away from the leaf;
increasing the concentration gradient (of water vapour);
- more transpiration in the light;
due to light causing stomata to open;
wider opening with brighter light hence more transpiration;
CAM plants opposite;
narrower stomata with high carbon dioxide concentration hence less transpiration; **[8 max]**

(Plus up to [2] for quality)

6. (a) *Name of diseases and group must both be correct for mark.*
virus – *e.g.* cold / influenza (flu) / polio / mumps / measles / rubella;
bacteria – *e.g.* pneumonia / “strep throat” / syphilis / cholera / whooping cough /
dental caries;
fungi – *e.g.* athlete’s foot / ringworm / yeast infection;
protozoan – *e.g.* amoebic dysentery / sleeping sickness / malaria; **[4 max]**
- Accept other suitable examples. For a viral disease, accept AIDS but not HIV. Do not accept symptoms that can be caused by more than one type of pathogen, such as diarrhoea.*
- (b) vaccine is used (to induce immunity artificially);
vaccine contains dead / weakened / attenuated forms of the pathogen / bacterium / virus;
vaccine is injected / ingested;
booster shot may be needed;
immunity due to vaccination / immunisation lasts for life / a long period;
immunity to a disease is due to presence of the appropriate antibodies / cells that can make them;
active immunity is when the body makes the antibodies itself;
natural immunity is caused by exposure to a disease / pathogen / bacterium / virus;
antibodies are made in response to antigens / vaccine;
memory cells are made in response to antigens / vaccine; **[6 max]**
- (c) *benefits:*
prevent disease;
prevent epidemics;
healthier society;
reduce medical costs;
less job absenteeism;
disease free cattle / more food;
eradicate diseases / smallpox entirely;
prevent harm / disabilities due to diseases;
speed up the body’s response to a disease;
- dangers:*
allergic reactions;
autoimmune response;
weakened virus becomes virulent / get disease;
danger of side-effects / example of side-effects;
vaccine with side-effects *e.g.* salk vaccine / whooping cough vaccine / MMR vaccine; **[8 max]**

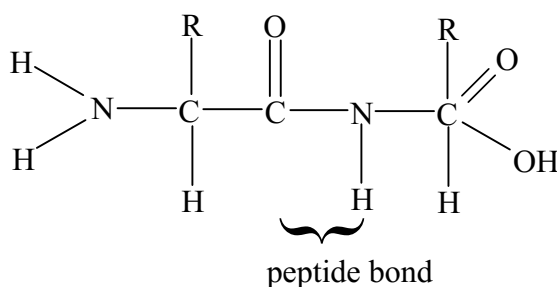
(Plus up to [2] for quality)

7. (a) carboxyl / COOH group of one amino acid reacts with amine / NH₂ group of another;
water / H₂O is eliminated;
These steps can be shown diagrammatically, e.g.



peptide / covalent bond is produced;

diagram of dipeptide, with peptide bond shown **[2 max]**;
e.g.



Award [1] if the two amino acids forming the dipeptide are shown correctly. The radicals can be shown as R or H. Award the second mark if the C-N bond is labelled as peptide bond or dipeptide bond. The label can include the H bonded to the N and the O double bonded to the C.

[5 max]

- (b) consists of initiation, elongation and termination;
mRNA translated in a 5' to 3' direction;
binding of ribosome to mRNA;
small sub-unit then large;
first / initiator tRNA binds to start codon / to small subunit of ribosome;
AUG is the start codon;
second tRNA binds to ribosome;
large subunit moves down mRNA after a second tRNA binds;
amino acid / polypeptide on first tRNA is transferred / bonded to amino acid on second tRNA;
peptide bonds between amino acids / peptidyl transferase;
requires GTP;
movement of ribosome / small subunit of ribosome down the mRNA;
loss of tRNA and new tRNA binds;
reach a stop codon / termination;
polypeptide released;
tRNA activating enzymes link correct amino acid to each tRNA;
(activated) tRNA has an anticodon and the corresponding amino acid attached;

[9 max]

(c) *Name of function and named protein must both be correct for the mark.*

storage - zeatin (in corn seeds) / casein (in milk);

transport - hemoglobin / lipoproteins (in blood);

hormones - insulin / growth hormone / TSH / FSH / LH;

receptors - hormone receptor / neurotransmitter receptor / receptor in chemoreceptor cell;

movement - actin / myosin;

defence - antibodies / immunoglobulin;

enzymes - catalase / RuBP carboxylase;

structure - collagen / keratin / tubulin / fibroin;

electron carriers - cytochromes;

pigments - opsin

active transport - sodium pumps / calcium pumps;

facilitated diffusion - sodium channels / aquaporins;

Mark first four functions only. Allow other named examples.

[4 max]

(Plus up to [2] for quality)
